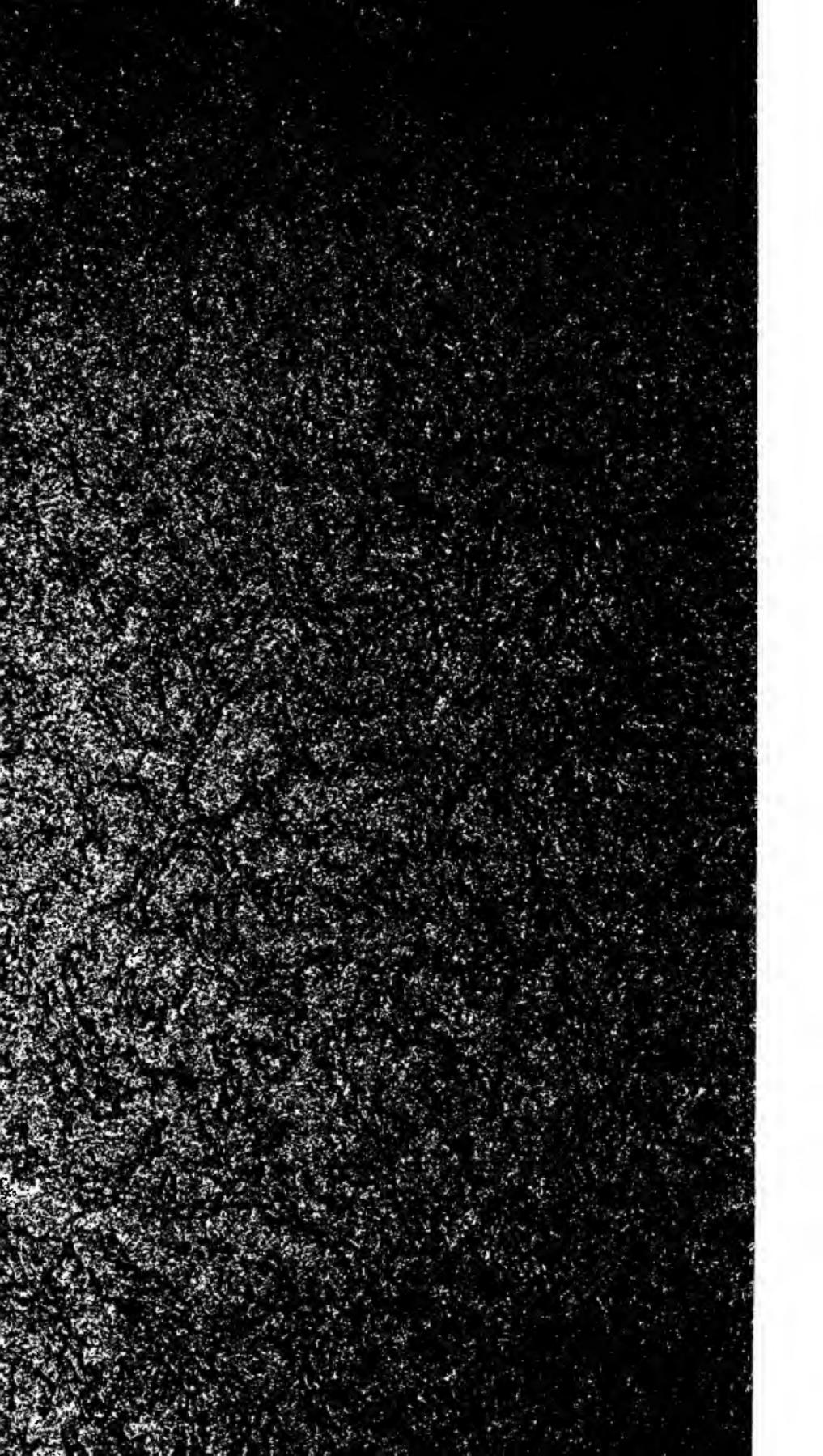


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INDUSTRIAL FATIGUE

And the Relation between Hours of Work and
Output, with a Memorandum on Sickness

BY

LORD HENRY BENTINCK, M.P.

LONDON

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A part of the material here presented appeared in an article in the *Contemporary Review*. I am indebted to the Editor for permission to include it.

I also wish to express my thanks to the Women's Industrial Council and to their investigator, Mrs. Croom-Johnson, for valuable work done in connection with the inquiry on which this pamphlet is based.

Industrial Fatigue

A REPORT upon Industrial Fatigue at the present moment must of necessity be somewhat incomplete in character. The study of the question is as yet in its infancy, the experiments already carried out are limited and there is still a vast field of work in front of pioneers who will investigate the whole matter in a scientific spirit. Both employers and workers fail as yet to understand that in industry it is not the *immediate* return which counts. They must take a much larger view and organise their factories and their counting-houses on a basis that will give the best of themselves and their workpeople for the whole of their lives to their country. The employer should grasp the fact that even if he loses a fraction of *this* year's profits by adopting shorter hours, his indirect gains in the future will be measured by a higher standard of work, of health, and of happiness on the part of his workers, with a consequent reflection of these benefits on the community in general. His profits, too, after perhaps an initial fall, are likely to maintain a steady increase. The workers, in their turn, must be taught to realise that high earnings for short spells are not remunerative, if they mean that their earning capacity spread over the whole of their working life, is thereby diminished by inferior health.

For the sake of the country, which will need the best energies of each of its citizens to repair the wastages of war, it is incumbent upon both masters and men to co-operate, to discover in each trade, and in each process of that trade, the "optimum" which a man can give during the day, the best conditions under which he can perform

INDUSTRIAL FATIGUE

his task, and the scientific way of doing his particular piece of work.

AUTHORITIES

The most recent and illuminating works on the subject of Industrial Fatigue are English.

- (1) The second Interim Report on an Investigation of Industrial Fatigue by Physiological Methods, made by Professor Kent under the auspices of the Home Office—1916. Cd. 8335.

The results of this investigation are so valuable that they should be studied with infinite care by all those who are trying to reduce the hours of workers.

Professor Kent is emphatic as to the best times for work, and his examples of the beneficial effect upon output of a shorter day are very striking.

They are discussed fully at a later stage of the report.¹

- (2) The Interim Report of the Health of Munition Workers Committee on Industrial Efficiency and Fatigue issued last year (1917, Cd. 8511). In compiling this, the Committee have had an advantage denied to the private investigator, the right of inspecting the books and statistics of munition factories all over the Kingdom.

The results have been most instructive and valuable; but the disappointing feature of the report is that the findings of the Committee have been largely negative.

On page 15, in a study of Industrial Fatigue, the Committee lament the lack of knowledge based upon the experimental science on industrial fatigue in England, and draw attention to the fact that America and Germany have given much greater study to the question. They point to the surprising uncertainty commonly found in this country, even where professional knowledge is to be expected, with regard to the proper solution of some of the most elementary practical problems of scientific management.

The article concludes: “The problems of industrial fatigue already soluble in part by reference to an available body

¹ See page 1.

of knowledge well known and used in other countries, have become acute during the great recent development of the munitions industries of Great Britain. It is not too much perhaps to hope that the study of industrial fatigue and the science of management based upon it, which is now being forced into notice by immediate need, may leave lasting results to benefit the industries of the country during succeeding years of peace. . . . It is certain that unless our industrial life is to be guided in the future by the application of physiological science to the details of its management, it cannot hope to maintain its position hereafter among some of its foreign rivals, who already in that respect have gained a present advantage."

Within the last few months a further memorandum has been presented on the subject of reduction of hours. The Committee have come to the conclusion that, in the light of all their latest investigations, the maximum hours of labour recommended in their previous report¹ are too long. These hours were 65 to 67 a week for men, and 60 for women.

They say now that they feel strongly that these hours should be reduced considerably, but that, in view of the variations in type of work and in consideration of the fact that a number of other factors have to be taken into account, such as housing facilities, transit, and the like, they do not feel competent to recommend any fixed scale of hours to the Minister of Munitions.

This memorandum is one of the most disappointing productions of an otherwise efficient series. This Committee have had the inestimable advantage of being able to inspect personally any engineering firms they liked, and have had in addition the services of a number of eminent experts for over two years, and if at the end of that time, when they feel strongly that the moment has come for a further reduction in hours of labour, they are not able to give any definite recommendations, one may well despair of any real constructive orders coming from them. It does not seem fair that they should throw all the responsibility on the Minister of Munitions, when presumably the Committee are in the best position to judge of the relative

¹ Memorandum No. 5.

strain of the various processes. Here is surely a task of great importance ready to be undertaken. If by a wise grading of types of labour they were able to determine the "optimum" hours to be worked (*a*) by men, (*b*) by boys, (*c*) by women, and (*d*) by girls in the different branches of the engineering trade, it would be of immense value to the Reconstruction Committee in helping the industrial world to set its house in order, and would serve as an admirable guide in settling the "optimum" hours in other professions and industries.

The other chief standard works on Industrial Fatigue are American in origin. Miss Goldmark's *Fatigue and Efficiency* is perhaps the best known, and she relies to a great extent on the physiological investigations of the Italian scientists, Mosso and Maggiora.

The economic aspect of the whole question is dealt with by Miss Hutchins and Miss Harrison in their *History of Factory Legislation* (P. S. King).

The Case for the Shorter Working Day—a work in two volumes by Felix Frankfurter and Josephine Goldmark—is a practically exhaustive collection of documents proving the benefit to output of shorter hours.

Another very interesting study of the comparative results of good and bad conditions of work may be read in Ida M. Tarbell's book, *New Ideals in Business*. In her introductory remarks she lays stress on the magnitude of the movement which is slowly making headway among the peoples of the world.

"However great the lack of efficiency and justice in American industry," she concludes, "it is undergoing a silent revolution. This revolution is centred in industrial management. Back of it lies a belated realisation that the responsibility for the weaknesses and unrest of our industrial life does not rest with the American workman, but with his employer.

"The stability of this new movement lies in the fact that management is summoning to its aid great forces which it has hitherto believed to have little or no part in its function. *It has summoned science, and growing numbers of American business managers are holding that there is no task which men perform which should not be treated scientifically.*

“Nothing can stifle these new ideals of Industry. Not only are the human heart and human intelligence with them, but human competition is forcing them.”

These truths, gaining ground daily in America, are beginning to be recognised among industrial magnates in England. The war, instead of retarding the advance of the science of management, has given it a great impetus. The withdrawal of large numbers of men from industry, their replacement by women new to the work, has brought to the forefront vital questions as to the best use which can be made of human labour. It is for those who are responsible in this country for the Reconstruction of Industry on the conclusion of peace to see that a considered, enlightened and scientific examination is made of all the problems arising from the new conditions in the world of labour.

THE RELATION BETWEEN HOURS AND OUTPUT SOME PRE-WAR EXPERIMENTS IN ENGLAND

In 1843 an inquiry made for the second Children's Employment Commission by Mr. J. L. Kennedy as to the cloth print works in Lancashire, Cheshire and Derbyshire, showed how the system of long hours resulted in deteriorated output.

Example.—One firm tried to run their mill 15 hours a day, and found that after the first month output began to fall off in both quantity and quality.

By the fourth month of the trial the spoiled work had doubled and production had fallen from 100 per cent. to 90 per cent.

They attributed this to the gradual exhaustion of the workers.

“The amount of spoiled work increased to such an alarming degree that the parties referred to felt themselves compelled to shorten the hours of labour to avoid loss.” (British Sessional Papers, 1843.)

Upon reducing the hours of labour the proportion of spoiled work promptly fell and output rose again.

By 1861 the President of the economic section of the British Association for the Advancement of Science wrote that it was generally agreed that it was precisely the changes

which had been brought about by the efforts to establish in manufacturing occupations a sound system of legal interference with the hours of labour, that had conferred upon us resources against the effects of foreign competition and had placed the manufacturing enterprise of the country upon a safe basis.¹

The chief agencies for obtaining results of hours and output for many years after this were the bi-annual reports of the factory inspectors.

These reports gradually formed an invaluable record of the effects of factory legislation.

Framed first for the textile mills in the North, the Factory Act of 1847 was gradually extended to include many other trades,² print works, bleacheries, lace factories, hosiery, hardware, &c., and as in each case hours were limited, the reports of the inspectors showed that in the long run manufacture profited by the curtailment.

In 1893 a very important experiment was undertaken by the Salford Iron Works, Manchester.

For a whole year the work was measured, and in 1894 the results were able to be seen.

Previous to the trial year the week's work was first 54 hours and later 53.

For the trial year it was reduced to 48 hours.

Results.—(1) Under the 48 hour week production increased. (Figures not given.)

(2) Though the piece-workers lost slightly during the year, their falling off diminished as the year advanced, showing a steady adaptation to the altered conditions of work.

In the first 3 months they had earned 1.76 per cent. less than the standard piecework wages.

In the second period they earned 1.58 per cent. less.

In the third period they earned only 0.78 less, so that at the end of the year the difference in all probability disappeared entirely.

(3) There was a great improvement in lost time.

Under the 53 hour system the time lost averaged 2.46 per cent.

¹ Reprinted in *Journal of the Statistical Society*, Vol. XXIV. 1861, page 463.

² 1864 and 1867.

Under the 48 hour system it only averaged 0.46 per cent.

The results of this experiment at the Salford Iron Works were laid by the heads of the firm, Messrs. Mather & Platt, before various government departments, and Mr. Mather was invited to explain the workings of the 48 hour week to the chiefs of construction at Woolwich Arsenal, and to the officials of the dockyards and the post office.

In 1894 the hours of labour of about 43,000 people in Government factories and workshops were reduced to an average of 48 hours a week.

In 1905, after trying the experiment for 11 years, *the War Office* stated that the following results had been noticed :¹

- (1) A saving in time through the greater promptness of men in stopping and re-starting work.
- (2) Greater regularity in attendance.
- (3) An improvement in the men's physical condition, with a consequent increase in working capacity.
- (4) Although piecework rates had not been increased, the average weekly earnings of the men had not been sensibly altered.
- (5) It had not been found necessary to increase the number of day-workers.

In 1905 *the Admiralty*, after trying the reduced hours for 11 years, reported :

That the cost of production at the dockyards compared favourably with the cost previous to the introduction of the 48 hour week,

but

They were unable to state to what extent the cost had been affected by the reduction in hours, on account of improvements in machinery, changes in the methods of conveying stores within the dockyards, increases of pay in certain trades, etc.

THE EXPERIENCE OF WAR

During the last three years the whole question has become

¹ *British Board of Trade Labour Gazette*, July, 1905.

so important that a mass of evidence on the effect of shorter hours is gradually accumulating.

Sir Robert Hadfield, in an interview published in *The Observer* of October 14, 1917, made some observations which get at the root of the matter.

He noted that for years employers in England had made an earnest and unsuccessful fight against the 48 hour week.

“Now, under war conditions,” he continues, “when it is necessary that we should produce at a maximum, we have turned to it, as a means to just that end and find it most efficient. . . . When the war broke out it was no longer a question of the greatest number of hours for the least pay; it had become a question of the greatest output in the shortest space of time.”

In view of the known results already achieved, it is difficult to understand the reason for the abandonment by the War Office on the outbreak of war of the real principle underlying the 48 hour week.

If the officials at Woolwich Arsenal really found that the shorter hours had had all the beneficial results which they reported, the prompt introduction of a 12 and even 14 hour shift can only be justified by the assumption that the war would be over in three months, and that work could be done at very great pressure for a short spell.

After over $3\frac{1}{2}$ years of war, it is surely time to realise that what was regarded in 1914 as a sudden and temporary pressure, calling for an unprecedented spurt, has now developed into the normal working hours of men and women, and it is therefore quite unreasonable to expect that the long shifts to which they have reverted are resulting in a correspondingly increased output. The evidence is all the other way, and it would be more enlightened of the Arsenal authorities to accept not only their own evidence as expressed in 1905, but also the testimony of countless other firms taken recently, which all prove that in order to maintain a large and steady output, the working hours should certainly not exceed 48 or 50 a week.

The beneficial effects of shorter hours on output may be studied in many different trades. The 48 hour week has not been standardised. Any innovation must be introduced gradually, but in the various industries in which reductions from longer hours to more reasonable ones have been tried,

the movement has been attended with marked success and has resulted in better work and a higher average output per worker.

In Memorandum 12 of the Health of Munition Workers Committee ("Output in Relation to Hours of Work," by H. M. Vernon, M.D.) there is abundant evidence of the value of a reduction in the existing hours, especially in the case of women.

(1) 100 women engaged in turning aluminium fuse bodies were examined.

Their hours were reduced from 74.3 to 67.5, and for some weeks the effect of this reduction was not manifest in increase of output. After about seven weeks, however, during which time there was a temporary shortage of material, which accounted partly for the falling-off in output, the effect of shorter hours began to show and the hourly output reached a maximum.

The relative output per working hour increased from 100 to 123 and the total output was 8 per cent. greater.

The actual hours worked during this later period were about 60 per week and Dr. Vernon is of opinion that these are still too many to give the best total output.

(2) On another occasion one group of 17 operatives worked only 51.8 to 62.6 hours per week for 5 weeks.

During the last three weeks of this period their hourly output was 18 per cent. greater than that of another group of operatives who were working the usual long hours.

Subsequently, when both groups worked the same hours their output was identical.¹

Engineering.—In a big engineering firm which has lately adopted a 48 hour week instead of one of 54 hours, statistics have been carefully collected and records taken of the wages earned for the four weeks preceding the change and for the four weeks following it.

Results.—(1) When the longer hours were worked there was a good deal of bad time-keeping.

Since the change to shorter hours there seems to be almost complete uniformity of hours worked.

Employees have lost practically no time at all.

¹ *Industrial Efficiency and Fatigue*, pp. 18 and 19.

(2) Out of 203 cases examined there were only four women who could not earn as much in 48 hours as in 54.

Those who worked quite steadily under both systems and lost no time earned slightly more working the shorter hours.

The work is paid by piece-rates, and therefore the output can be measured by the earnings of the workers.

The actual earnings are scheduled separately in Appendix A.

Printing.—In the printing trade, where the hours were reduced just before the war from 53 to 50 hours weekly, the same results appear.

After watching very carefully the results of the shortened hours the Works Manager of one big firm came to the following conclusions :

- (1) That he gets more output per head now that shorter hours are worked, in spite of the fact that his labour has been scarce, fluctuating, and to a great extent new and unskilled.
- (2) That overtime is of no use for more than a fortnight. At the end of the second week he has always noticed a marked falling off in the *quality* of the output and has then promptly stopped the overtime.
- (3) That pre-breakfast work is entirely useless.

Textiles.—In the Textile Trade, in Yorkshire, a compulsory shortening of hours in order to save raw material resulted in an increased output.

At one big mill the hours were reduced from $55\frac{1}{2}$ per week to 45, and this resulted in an *immediate* reduction in output of 10 per cent.

After a few weeks on the shorter hours the reduction in output was lessened to 5 per cent., and with a later increase of hours to 50 weekly the output went up to a higher level than it had ever been in a $55\frac{1}{2}$ hour week.

Shirt Factory.—In a shirt factory, working 10 hours a day, the average wages earned by the women were 6s. 6d. to 7s. a week. An 8 hour day was introduced, and instead of the earnings sinking to vanishing point, as they antici-

pated, the workers found that they practically doubled their output and earned on an average 14s. a week.

Clerical Work.—The output in clerical work is not so easy to measure, but from various experiments made and records taken, there is abundant proof that in work which involves mental concentration the hours worked normally in offices might be shortened with advantage to the quality of the work done.

In a correspondence office in which the kind of clerical work lends itself to measurement, it was found that 40 per cent. of the total day's output was done in the first $2\frac{1}{2}$ hours, 31.85 per cent. in the second period of $2\frac{1}{2}$ hours, and 28.15 per cent. in the third period of $2\frac{1}{2}$ hours.¹

In the office of a Railway Company some years ago the lack of a sufficient staff led to an accumulation of arrears, and in order to cope with them the members of the Staff worked for several months from 9 a.m. until midnight.

They made no impression on the arrears at all; in fact the accumulation became greater, and at last the Chief of the Office said that whatever happened he would not allow such long hours to continue.

He insisted that all work should cease at 6 p.m.

Shortly after the shorter hours were adopted it was found that the arrears were being gradually overtaken, and at the end of a few months there were none left.

Thus it appears that a great deal more work was done with 6 hours' less time per day.

Drapery.—The Drapery Trade has given a good deal of thought to hours and industrial fatigue of workers in sedentary occupations, and as the result of careful consideration they have decided upon 48 hours a week as the "optimum." They found that fewer hours had a considerable effect on output, but that longer hours resulted in over-fatigue and consequent loss of time.

They have therefore standardised the hours at 48 and emphasize the importance of a week-end rest. They consider that the weekly half-holiday is of infinitely greater value to employees on Saturday than in the middle of the week.

¹ See Appendix B.

Kent Report.—Perhaps the most striking instances of increased output under shorter hours are to be found in Professor Kent's report.¹

A number of tests were made in the winding room of a factory engaged in making surgical dressings.

The majority of the workers worked 12 hours a day. One woman decided for herself that she could do more in 8 hours, and accordingly worked only from 8.30–5.30.

Her work was compared carefully with that of three other women, adhering to the ordinary day of 12 hours. In 160 hours her total was 52,429 bobbins as compared with an average of 48,529 bobbins in 236–7 hours from the other three workers.

A group of workers showed an absolute increase of 5 per cent. of output when the length of their working day was diminished by 16½ per cent.

Another group increased their average rate of output from 262 to 276 as a result of shortening the day from 12 hours to 10, and to 316 on a further shortening of the day to 8 hours.

These instances of increased output under shorter hours have all been drawn from British manufacturing firms and are of quite recent date.

Examples of greater production in consequence of a decrease in hours of labour may easily be multiplied by taking into account investigations made in America, Belgium and Germany.

A few examples have been collected and will be found separately under Appendix C.

In every case, whether at home or abroad, in which experiments have been tried to determine the result of a shorter working day, the result has been favourable to a decrease of existing hours.

SICKNESS, LOST TIME AND SPOILED WORK

A. SICKNESS

Before 1912 very few reliable figures could be found for the purpose of estimating the effects of employment on the health of the community.

¹ See *Industrial Fatigue*, by A. F. Stanley Kent, M.A., D.Sc., pp. 32–44.

Even now, when the statistics accumulated by the National Health Insurance Commission are in existence, it is not so easy as might be expected to frame a comparative study of sickness returns in different industries.

Unfortunately, before sufficient time had elapsed to allow the Act to get into efficient working order, war broke out and a number of new factors arose which complicate very greatly any conclusions to be drawn from the available figures.

Owing to insufficient staff, statistics on the subject have been neglected by most of the friendly societies, and in general all that can be relied upon is the expression of opinion of those responsible for the payment of sickness benefits.

In every case the same opinion has been advanced.

✓ The effect of the long hours which have prevailed in so many industries since the outbreak of war was not immediately apparent. ~First, the patriotic desire of the workers to do their utmost for their country prevented their giving way to minor ailments, and slackening their output. ~ Then continuous employment and higher wages resulted in their obtaining better and more plentiful food, and this reacted in a very marked way upon their efficiency. Fatigue, which might have been expected soon to show itself, was staved off because the higher standard of living gave the worker much greater powers of resistance and endurance. ~

Then a third factor intervened. The continuance of high wages in the industries which were working the longest hours had a double effect. Firstly, workers would not risk losing them for the sake of any ailment not in itself serious; ~secondly, if they did succumb and absent themselves from their work for a few days, they were so much better off that often they did not bother about claiming sickness benefit.

Another point, too, must be taken into account. There are a great many women working now who have never worked before. They have joined a Society but do not know what to do with their cards. If they become ill they do not claim from their Society, but still consult their own doctors and consequently they do not appear at all in the sickness returns.

The general opinion of the heads of friendly societies

is unanimous as to the cumulative effect of the long hours on the health of employees.

They say frankly that their sickness claims dropped with great suddenness in the early part of 1915 and remained low during that year and 1916.

In the early part of 1917, however, the effects of good food and a higher standard of living began to be counterbalanced by the accumulated fatigue of nearly three years of war, and the sickness rate began to go up. It has become much more marked during the second half of 1917 and they now expect a steady rise until the end of the war, unless there is a radical change in the hours of labour and an abolition of so much overtime and night work.

There is also complete unanimity of opinion about the ill effects of night-shifts. It is noteworthy that in any factory working at night the rate of sickness is unduly high.

In spite of a general lack of statistics, however, it has been possible to obtain accurate figures for various trades, and they have been grouped together in Appendix D. In compiling them great care has been taken to underestimate rather than over-estimate the number of claims arising from the hours and conditions of work. Every possible allowance has been made for illness arising in the ordinary way, and the following have not been included at all.

- (1) Cases of members who had been in receipt of total disablement benefit in the year preceding and whose disablement benefit was continued during the year under review.
- (2) Cases of discharged soldiers whose illnesses arose obviously from their wounds or other illness incurred while on active service.
- (3) Pregnancy or Maternity claims or any illnesses arising from confinements.

The illnesses directly traceable to over-work are those outlined in Memorandum 10 of the Health of Munition Workers Committee—overstrain, general debility, myalgia (an overstrained muscle), neuritis and neuralgia, anaemia, and a bad outbreak of catarrh or bronchial catarrh when it has occurred during the hot weather.

Influenza has not been included because it is infectious, but there is no doubt that in many cases it has spread rapidly in a factory owing to the impaired vitality of the workers.

Three different trades have been examined, in all of which long hours are worked.

At Woolwich Arsenal the amount of overtime worked is too well known to need emphasizing.

In the Hosiery trade, before the war, the average number of hours in a full week was 53.9, and 67.9 per cent. of the workpeople engaged in it worked about 55 hours a week. There has been a pressure in this trade due to war requirements and a good deal of overtime.

In the Jute Industry the hours, too, have always been very long. For over 99.6 per cent. of the workers the hours have never been below 55 weekly.

A comparison of the figures from these three trades taken during 1916 give most instructive results.

At Woolwich, out of 634 men belonging to one society, 334 claimed sickness benefit during the year—a percentage of 52.6!

The number of claims directly attributable to strain was 94 and the percentage 28.

In the summer of 1916 no less than 11 per cent. of the members were attacked by bronchial catarrh at the same time. This was attributed to the night work. The men got very hot, and cold night air blowing in for ventilation gave them a chill.

It is significant that at Woolwich Arsenal doctors are now diagnosing Industrial Fatigue as a recognised illness.

The amount paid out during 1916 in sickness benefits to these men at Woolwich exceeded by more than 50 per cent. the amount estimated by the actuaries.

If the sickness rate at the Arsenal has been so high among the men it would be very interesting to have the figures for the women. They have been carefully kept by the Lady Superintendent, so that it should not be difficult to collect them. It is not possible to obtain them from Friendly Societies, because the women are insured under their previous occupations and scattered among a number of societies.

In looking at the figures of the three hosiery factories

(see Appendix D, pages 40-41) two facts stand out with great clearness.

(1) In each case the percentage of the women suffering from strain is very much higher than that of the men.

	The Percentage of Men's Claims.		The Percentage of Women's Claims.
Society A . . .	6.6 per cent.	..	18.6 per cent.
Society B . . .	13.04 "	..	30.4 "
Society C . . .	14.2 "	..	32.6 "

In the last two factories the figures for the women seem disproportionately high and tend to prove that long hours worked continuously by women have a very much more marked effect upon their health than has hitherto been thought probable.

(2) In comparing the figures for the men engaged during long hours in the hosiery and jute trades with those for the men at Woolwich Arsenal, it is seen that the percentage both of sickness generally and of sickness arising from their conditions of work is very much greater among the munition workers. This may without doubt be attributed to the added strain of night-work at Woolwich and shows clearly the ill effects arising from working long hours plus night shifts.

B. LOST TIME

Professor Loveday, in his report on the Causes and Conditions of Lost Time,¹ emphasises his opinion that sickness, as a factor of lost time, has been greatly under-estimated and slackness over-estimated.

A man who has been working at high pressure and for long hours, by missing the "pre-breakfast" quarter of work, and by starting his work occasionally at 8.30 instead, saves himself from a serious breakdown and much greater loss of time.

Workers are only obeying a natural instinct of self-preservation when they sometimes elect to stay in bed for an hour or two extra.

It is a recognised procedure among munition workers, and as their condition is simply one of over-fatigue and not a specific illness of any sort, it appears in factory records of time-keeping as avoidable lost time, due to slackness,

¹ Embodied in Cd. 8511.

and no account is taken of the fact that but for this "avoidable" lost time there might be a very much higher percentage of "unavoidable" lost time, with the worker away from his post for several weeks in consequence of a nervous breakdown.

If the effect upon output of a high percentage of avoidable lost time is considered, it will be readily conceded that long hours plus lost "quarters" are economically very extravagant. The output of any shop which could rely upon the regular attendance of its workers would be greater in 9 hours than that of a shop working $10\frac{1}{2}$ where disorganization from lost time is bound to be considerable.

In every case of hours being shortened the amount of lost time has been considerably reduced. It will be remembered that in the experiment of Messrs. Mather & Platt at the Salford Iron Works¹ the improvement in time-keeping was most marked. Under the 53 hour system the average of lost time was 2.46 per cent. When 48 hours only were worked, the average of lost time sank to only 0.46 per cent.

Aeroplane Factory.—In an aeroplane factory in London, where the Manager has never believed in long hours and will not work them, he reports that the amount of time lost by his workpeople is absolutely negligible. They are never exhausted when they cease work, and are consequently never absent through sickness or staleness.

His output is therefore steadily maintained and in any emergency or unexpected pressure he can rely upon a ready response from his workers.

The hours in this factory are only 55-58 for men and 48 or 49 for women.

It is especially to be noted that he has never known of any case of breakdown among his women.

A correspondent in *The Times* of September 13, 1917, who wrote as Chairman of an Engineering Works, stated that as the result of a statistical examination of the work over a period of three months following a reduction in hours from 54 to 48 per week, they found that:

- (1) The output had increased by 44 per cent. under the shorter hours.

¹ See page 13 of this report.

(2) The loss of time per woman per week was very largely reduced.

In a further letter on September 17th he stated that with a 54 hour week the average loss of time per woman was 12 hours a week, making the effective week 42 hours.

When the hours were reduced to 48 the loss of time per week was only 4 hours, making an effective week of 44 hours.

It is therefore not surprising that the output was increased considerably.

Instances of the effect of long hours upon lost time will be found in Appendix E of this report, under a separate study of cases taken at a Munitions Court.

In considering the subject from every point of view the advantage to output of shorter hours and the elimination of lost time seems indubitable.

C. SPOILED WORK

Any study of the effect on output of shorter hours would be incomplete without a reference to the elimination of spoiled work following upon a reduction of hours. The question of spoiled work is closely bound up with sickness and lost time, because in many instances it is a result of the former and a cause of the latter—in the sense of time lost *inside* and not *outside* the factory.

In the Introduction reference was made to the attempt of a firm to run their mills 15 hours a day.

It was found that by the end of the fourth month the spoiled work had doubled, owing to the gradual exhaustion of the workers. In the British Sessional Papers, 1843, Vol. XIII, p. 72, it is reported that "the amount of spoiled work increased to such an alarming degree that the parties referred to felt themselves bound to shorten the hours of labour to avoid loss."

This is doubtless an extreme instance, but it serves to show the effect on the quality of work of exhaustion or staleness on the part of the worker.

It is self-evident that fatigue must result in deterioration in both quantity and quality of output, for even if the employee remains at work, unless she is physically

fresh the amount of spoiled work will be disproportionately large.

It is equally true, though not quite so obvious, that spoiled work is the cause of a great deal of wasted time during factory hours. Holden A. Evans wrote once that "very few owners or managers realise the enormous amount of time wasted by men in their employ," and this waste is caused largely by small defects in machinery due to carelessness or inattention of the man working it.

In this connection there is another point which deserves more study than it receives at the hands of those who aim at as large an output as possible. It does not follow that output is greatest when the machines are speeded up to their full capacity. It is of no use to speed them up to a limit at which the worker is unable to do her work without making mistakes.

In the United States speeds in spinning mills were reduced in several cases in order to get the best results.

It was found that spinners who used to care for 800 spindles and 8 sides could turn out more and better work with 600 spindles and 6 sides. The revolutions per minute of the spinning spindles were reduced from 8,000 to 7,600 because it was a more efficient speed.¹

The worker gets less tired and the output is greater when the machine is kept at a level at which the worker can work easily and efficiently without making mistakes.

Accidents must also come under the heading of spoiled work and wasted time. Under Appendix F it will be seen that the highest percentages occur between 10 and 12 in the morning and between 5 and 6 in the evening at the end of long spells of work.

If each works manager considered how best to arrange his spells of work so that his employees never became unduly exhausted the result would be seen very speedily in a decline of accidents both to the workers and machinery, and the number of hours gained by the elimination of accidents—however trifling they may be—would greatly outweigh the amount of time lost by shortening hours and introducing short pauses for rest.

¹ Tarbell. *New Ideals in Business*, p. 211.

CONCLUSIONS

In a general survey of the best means to secure the greatest possible output in the shortest possible time, it is not perhaps out of place to refer briefly to three other factors which have very important effects upon output.

- (1) Good lighting.
- (2) Good ventilation.
- (3) Avoidance of monotony in work.

1. GOOD LIGHTING

Mr. Schwarze, in a handbook on shop lighting, declares that the results of experiments show that it increases output from 2 to 10 per cent.

He writes: "In a certain steel plant, where an efficient lighting system was installed, the output at night was increased a little over 10 per cent. In order to determine whether this was due wholly to the introduction of the better lighting conditions, the lamps were taken out, and for a time the work was carried on at night with the old lighting system. It was found that the amount of work dropped off over 10 per cent.

"When, however, the work was resumed under the improved conditions the men were able again to produce 10 per cent. more work."

2. GOOD VENTILATION

There is the same relation between output and ventilation.

The Hamilton Watch Company found that after the installation of proper ventilators, the operatives did the same amount of work in 9 hours that they had formerly done in 10. This instance of improved output due to better conditions could be multiplied indefinitely.

3. AVOIDANCE OF MONOTONY IN WORK

It is difficult with repetitive processes to avoid monotony, but the added strain of performing year in and year out

the same little process over and over again should be taken into account when judging of the fatigue resulting from long hours.

A woman engaged as a sock-linker in the hosiery trade at Leicester writes bitterly about the lack of consideration shown by those in authority regarding the strain attendant upon this particular work.

"For some unknown reason," she says, "we sit upon very low stools, and only get up about twice a day to fetch work, which only takes about five minutes. No department in the trade is quite so trying as that of a linker. Sock-linking is really worse than jersey-linking, on account of its being so very monotonous.

"One sock takes about 20 seconds to do, and all the others are an exact repetition."

She adds that the work is especially trying to the eyes and nerves and that for the first two years of the war, when the hours worked were from 8 a.m. to 8.45 p.m. with only $1\frac{1}{2}$ hours' break for dinner and tea, "the strain was awful."

Probably if these girls were allowed a short break of 15 minutes both during the morning and afternoon, not only would they be spared the nervous breakdowns common now among this kind of worker, but their actual output would be very much greater.

In one large printing works the Manager declared that monotony of work was responsible for a great deal of slackness and accounted largely for accidents.

He is in the habit of watching his output very closely, and when he finds a slackening he changes the worker to a different process altogether.

In this way he says that two results are attained :

- (1) Steadiness of output—since change of work invariably operates favourably on output.
- (2) A more highly skilled worker, since the fact that she can do several different processes broadens her mind and reacts favourably upon her work.

SUMMARY

With all these facts agreed as to the benefit to both workers and output resulting from a reduction in hours, the difficulty still remains of the best way to get rid of a bad system.

After convincing himself as to the advantages derived from the shortening of hours and the abolition of overtime, the employer has still the most difficult task in front of him—that of convincing his workers. They may argue that with the introduction of canteens and an efficient welfare organisation, they do not feel in the same way the strain of the long hours. That is true. Welfare work, canteens, trained nurses and rest rooms have done much in the last three years to mitigate the evil effects of the overtime which has been worked ; but things good in themselves should not be misused to bolster up a bad system. Without all this welfare organisation it would not have been possible to have endured the long shifts which have been worked, and it is very questionable whether it would not have been better for the welfare work to have been a little less efficient, so that the ultimate evil of the prolonged strain would have shown itself before.

However good in itself, welfare work could not hope to counteract entirely the strain and fatigue of so much overtime ; it has merely postponed the day of reckoning, and in so doing has very probably retarded reforms which, had they been adopted long ago, would have resulted in a much greater quantity of work, and a much higher standard of health among the workers.

The main objection to shorter hours on the part of the workers, however, will be on the financial ground. No one wishes to work abnormally long hours for the sheer joy of staying in the factory until he is dead tired. The reason of his endurance of the long spell of work has been his desire to earn the high wages which he thought only these hours could bring.

Any reduction of hours can only be gradual, and if the change is to be made without friction between the employer and his workers, the employer will have to adopt the same plan that has been followed by all the pioneers of shorter hours.

He will have to call together his workpeople and explain to them that his motive is not to cut rates and to economise. ⁺He must make it clear to them that those paid by time rates will receive just as much for the shorter as they did for the longer hours—or at any rate, the time rates must be so adjusted that an adequate living wage is guaranteed.

Then the problem of the piece-workers must be met, and it is here that the greatest difficulty will be found. The employer should endeavour to explain that the adjustment is an experiment ; that it is made with the sole desire of trying to discover the number of hours during which a man can give his best ; and that, as soon as this "optimum" is found, the worker will discover that his earnings will be as high, or perhaps a good deal higher, than they were before. [~]It should be pointed out that at the beginning the earnings may fall, but that this will be temporary, and that as soon as the benefit of increased rest has had time to assert itself, he will find that he can put more work into the shorter hours than he ever did in the longer ones ; that he will not have to take half days off, because he feels overtired ; and, most important of all, it should be impressed upon him that if at the end of three or six months, it is found that he is earning considerably more than he ever did, *his piece-rates will not be cut*. He will reap the full benefit of the improvement in the quality and quantity of the work.

The employer should make it clear that it is an experiment, and that if at the end of a given time, say six months, it has been found a failure, the whole question may be reconsidered ; but he might add that in every case in which a fair trial has been given to the shorter hours, health has improved, output has increased and the cost of production has been lowered, so that both employer and work-people have benefited, and in no case have the workers ever wished to revert to the longer hours.

The theory that in each trade, and in each process, there is an optimum number of hours which can be worked with the best results, can be explained very simply and clearly, and if it is pointed out that when by loyal co-operation between employers and labour this optimum has been discovered in every industry, it will result in an increase

of production and a corresponding increase of individual and national prosperity, there is very little doubt that the innovation will be begun in a friendly spirit with a genuine desire that it shall turn out a success.

Appendix A

ENGINEERING FIRM¹

The following are typical cases:—

	Average Wages during 54 hour week.			Average Wages during 48 hour week.		
	£	s.	d.	£	s.	d.
A	.	.	.	1	0	3
B	.	.	.	1	10	0
C	.	.	.	0	18	11
D	.	.	.	0	11	9
E	.	.	.	1	3	6
F	.	.	.	0	12	4
G	.	.	.	0	11	9
H	.	.	.	0	15	11
I	.	.	.	0	10	10
J	.	.	.	0	19	6
K	.	.	.	0	19	7
L	.	.	.	0	9	0
M	.	.	.	0	18	6
N	.	.	.	1	0	4
O	.	.	.	1	0	9
P	.	.	.	0	11	3
Q	.	.	.	1	0	0
R	.	.	.	1	0	4

A great many girls worked very irregular hours on the 54 hour week, and these settled down to a steady 48 hour week when the change was effected.

There are several interesting instances of workers turning out exactly the same output in a 48 hour week as in a 54.

1. In one instance

the hours worked were 54, money earned 15s. 9d.

56 $\frac{1}{4}$, " " 16s. 3d.

54, " " 15s. 9d.

When the shorter shift came in, the woman worked for 48 hours steadily. The first three weeks she earned 15s. 9d. a

week, but the last week her wages suddenly went up to 17s. 9d. This is another instance of the beneficial effect of shorter hours on output not being immediately established. It is generally established, after about three or four weeks, in cases where the work and machinery are exactly the same.

2. In another case a woman's earnings for 54 hours were 21s. This fell to 18s. 8d. for the first week after the reduction in hours. She earned 19s. 6d. during the second week, 19s. 7d. during the third week, and at the end of the fourth week had earned 21s. again, exactly the same as she had done in the 54 hour week.

3. Another instance is rather remarkable :

A girl earning 18s. 5½d. and 17s. 9d. during 54 hours, earned at once 22s. 6½d., 19s. 5d. and 19s. 1d. in 48 hours, and in the fourth week rose to 23s. 7d., an increase of nearly 6s. a week, with 6 hours less work.

4. Another girl who for some reason appears to have worked much longer hours than the others finds the relation between her hours and earnings as follows :—

In 61 hours she earns 22s. 9d.
" 63½ " " " 23s. 7½d.
" 58½ " " " 21s. 8d.

She then tries shorter hours :

In 53½ hours she earns 35s. 4d.

and encouraged by this tremendous increase she again tries longer hours, with the result that :

In 58½ hours she earns 31s. 6½d.
" 60¾ " " " 32s. 11d.
and in another 60¾ " " " 32s. 10½d.

This table seems to point to some definite conclusions.

(a) The week when she worked least hours she earned most money.

(b) Though as her hours became longer her output actually declined again, the week when she had more rest seems to have exercised a beneficial effect upon the standard of her work, for although she tried working 60¾ hours again, her output did not sink back to the level at which it was before she had the one much shorter week.

It seems probable, therefore, that even one week's shorter hours had a marked effect upon her efficiency.

It should be noted that her high-water mark of output was reached easily during the week when she worked least hours.

5. Another girl whose earnings during a 54 hour week averaged 26s. 4d. and never rose above 27s. 1d., under a 48 hour week, averaged 27s., and rose to 27s. 5d.

6. In another case the difference is even more marked. A girl who in $51\frac{3}{4}$ hours earned anything from 13s. 2d. to 17s. 9d. weekly, earned in four weeks of 48 hours 21s., 20s. 5d., 21s. and 20s. 5d.

This increase is especially noteworthy.

7. A girl earning an average of 16s. 10½d. in $49\frac{3}{4}$ hours earned 22s. 2d. easily when her hours were reduced to 48.

8. A girl whose earnings averaged 21s. 9d. for a 54 hour week earned 27s. 6d. when working 48 hours.

9. Another very steady worker whose maximum for 54 hours was 20s. earned 29s. 10d. in 44 hours, and maintained a steady 26s. in three succeeding weeks of 48 hours each.

10. A girl whose earnings were invariably exactly 20s. for 54 hours managed to raise her weekly wage to 26s. regularly on 48 hours a week.

These cases are those where the difference seemed most marked, but the important fact to be noted is that in no single instance did the earnings decrease in the same way. In four cases out of 203 they decreased very slightly, but there was nothing appreciable.

These statistics, therefore, are most valuable in proving that in this particular trade at any rate a reduction in hours has led to a very marked increase in output, and at the same time has benefited both employer and employee by being conducive to absolutely regular work, the amount of lost time under the new scheme being infinitesimal.

Appendix B

REPORT OF CLERICAL WORK DONE IN A CORRESPONDENCE OFFICE

The Head of the Office says :

“ Dividing the day into three periods of approximately $2\frac{1}{2}$ hours each, I find the percentage of work done is as follows :

9.30-12.0	.	.	.	.	.	40	per cent.
1.0-3.30	:	:	:	:	:	31.85	„
3.30-6.0	:	:	:	:	:	28.15	„

This average is really quite a rough one because in some rooms I found that the afternoon hours yielded the best work. One thing is certain, *that in every instance the evening hours, that is from tea-time until 6 o'clock, showed the lowest figure.*

9.30-1.30.	2.30-Tea 4 p.m.	4.20 (tea)-6.	Total.
57	..	22	100
68	..	19	108
61	..	33	110
—	..	28	49
76	..	29	124
64	..	22	98
61	..	16	91
57	..	23	96
65	..	17	94
49	..	20	86
50	..	26	90

RATIO.	Output per hour.		Totals.	
	Morning.	Afternoon.		
4 hours.	3½ hours.	4 hours.	3½ hours.	Totals.
57	..	43	..	100
68	..	40	..	108
61	..	50	..	110
Holiday	..	49	..	49
76	..	48	..	124

4 hours.	3 hours.	Output per hour.		3 hours.	98
		4 hours.	3 hours.		
64	34	16	11.3	..	98
61	30	15.25	10	..	91
57	39	14.25	13	..	96
65	29	16.25	9.6	..	94
49	37	12.25	12.3	..	86
50	40	12.5	13.3	..	90

CONCLUSIONS FROM THESE FIGURES

1. The output per hour in the morning was invariably greater than the output in the afternoon.
2. On the 4th day the Clerk had a holiday in the morning. The next morning the output was much greater than it was on any other day and rose to an average of 19 per hour in the morning and was quite a good average of 13.7 per hour in the afternoon.
3. The somewhat lower figures of the last six days are hardly fair tests as the statistics were compiled unfortunately during an air-raid period, so that the falling off in output during the last six days may be accounted for by the lack of proper rest at night.

Appendix C

UNITED STATES GRANITE CUTTING

A letter from William Crawford, President of W. J. Crawford & Sons, to Mr. Duncan, International President Granite Cutters Associations, December 19, 1912, contained the following interesting facts :—

Accurate records were kept by the firm and it was found :

- (1) A man accomplished more in 9 hours than he did in 10.
- (2) The same man accomplished more in 8 hours than he did in 9.

Mr. William Crawford went on to say that he believed that a man in the granite-cutting trade would do just as much in 7 or even 6 hours as he did in 8.

Mr. John A. Fitch writing in 1910 in *The Steel Workers* instanced the Sharon Steel Hoop Company, who up to 1904 had worked two shifts of 10 hours each.

In 1904 they tried making three shifts of 8 hours. The men were paid by piece-work ; it was found that their earnings were not reduced. They turned out as much in 8 hours as they had previously done in 10.

Mr. Frank Sheridan of the Bureau of Labour reported in 1905 on the work of two battleships, the *Connecticut* and the *Louisiana*.

The *Connecticut* was built under the 8 hour day and by Union men. The *Louisiana* was built by contract under a 10 hour day. The keels of the two battleships were laid within a month of one another, and it was well understood that there would be a race between the two sets of labour.

After careful records had been taken it was found that the average output of a man per hour was 24.28 per cent. greater on the *Connecticut* (8 hours) than on the *Louisiana* (10 hours).

The progress of work on the *Connecticut* more than kept pace with the progress on the *Louisiana*. On November 1, 1904,

the *Louisiana* reported 60·7 percentage completed, while on the *Connecticut* 63·9 was completed, although the keel of the *Connecticut* was laid over a month later than that of the *Louisiana*.

METALS

Messrs. J. H. Williams & Co. in 1901 reduced their hours from 10 hours a day to 9 hours a day, with 10 hours' pay—running 54 hours weekly for the wages heretofore paid for 60 hours.

The output of the works became slightly larger than before. *A comparison of a large number of orders executed on the same basis with the same number of orders for the same goods executed under similar conditions on the 10 hour basis showed a slight average gain in favour of the 9 hour day.*

There was a slightly larger average output for the 9 hour day than the 10 hour day. There was throughout an increased rate of hourly output and a total output somewhat larger for the shorter working time.

SHOES

Report of New Jersey Bureau of Statistics of Labour Industries. 1905.

In a large shoe manufactory in Boston the working hours had been 59 per week until July 1, 1898.

A change was then made which brought working hours down to 53½ per week.

Result.—No change was made in daily wages, and the result was a reduction in the labour cost of 1 per cent., and at the same time the product per employé increased 2½ per cent.

In Massachusetts managers of Cotton Mills stated that after adopting a 10 hour day voluntarily in place of an 11 hour day they found that their mills were as profitable to them under the shorter as under the longer time.

They attached more importance to skill in management and thoroughness in discipline than to the 11th hour in the product of a mill.

Thorough discipline was much more obtainable under 10 than under 11 hours, for the men and women cannot be held up to such steady work during 11 hours as during 10.

In one large cotton mill the hours had been 13, and the weekly product was 90,000 yards of print cloths.

The hours were reduced to 11, and with the same machinery the weekly product rose to 120,000 yards.

BELGIUM

CHEMICALS

Results found by Mr. Fromont at the Engis Chemical Works.

The productivity of the workman is measured with absolute exactness, since his work is, so to speak, weighed.

The general conditions of work have remained the same.

Results.—In an 8 hours day ($7\frac{1}{2}$ hours' actual work) the same men at the same furnaces with the same tools and raw material have produced as much as before in a 12 hour day (10 hours' actual work).

It goes without saying that the cost of production per ton is less, that wages are the same, and that both employer and men are benefited.

GERMANY

GLASS

Extract from a paper by Ernest Abbé on "The Economic Significance of a Shorter Working Day."

Herr Heye, the proprietor of large glass works of Gerrisheim, near Düsseldorf, reduced the working day from 12 and 11 hours to a normal 8 hours.

He reports that in a very short time there was produced, without increase of staff, as much as before the reduction.

When they reduced the hours from 9 a day to 8 a day they found:—

- (1) 30 men did as much in 8 hours as 31 men did in 9 hours.
- (2) Even if all the work was paid by results, the increased output is only temporarily obtainable by lengthening the hours of work, and after a short time the output under lengthened hours falls back to what it was in the shorter day.
- (3) Even where workmen have no interest in doing as much in the shorter hours; where, on the contrary, they have interest in *not* doing as much, nevertheless the same result is obtained—no diminution of product occurs.

It follows therefore from these results that if a man can do a certain day's work in 8 hours and he is compelled to spend 10 hours at it, it is pure waste power of men.

The length of working hours comes up for consideration in three different aspects:—

- (1) Shortened hours and increased intensity; exertion the same if certain limits of speed are not exceeded.

- (2) In estimating the "wasted power" of man, analogy with the machine.
- (3) In considering occupation (shorter work—longer time for rest).

Without pressing mathematical conclusions further it is evident that, when this relation of work to rest is correctly grasped, the shorter day not only leaves the day's output unchanged but may improve it.

If we could accurately gauge the mathematical relation we would find that there was an "Optimum" for each person, namely, the shortest possible time in which the longest possible product could be achieved.

Appendix D

WOOLWICH ARSENAL SICKNESS RETURNS

Total Membership	.	.	.	.	.	.	.	634
No. of Claims	.	.	.	.	.	.	.	334
Percentage of Claims	.	.	.	.	.	.	.	52.6
No. of Claims directly attributable to work	.	.	.	.	.	.	.	94
Percentage of Members whose claims were directly attributable to work	.	.	.	.	.	.	.	13
<i>Percentage of Claims directly attributable to work</i>	.	.	.	.	.	.	.	28

SOCIETY A

HOSIERY

Men.

Total Membership	.	.	.	.	.	.	.	179
No. of Claims	.	.	.	.	.	.	.	30
Percentage of Claims	.	.	.	.	.	.	.	16.7
Claims directly traceable to strain	.	.	.	.	.	.	.	2
Percentage of Members whose claims were directly traceable to strain	.	.	.	.	.	.	.	1.1
Percentage of Claims directly traceable to strain	.	.	.	.	.	.	.	6.6

Women.

Total Membership	.	.	.	.	.	.	.	522
No. of Claims	.	.	.	.	.	.	.	124
Percentage of Claims	.	.	.	.	.	.	.	23.7
Claims traceable to strain	.	.	.	.	.	.	.	23
Percentage of Members whose claims were traceable to strain	.	.	.	.	.	.	.	4.4
Percentage of Claims directly traceable to strain	.	.	.	.	.	.	.	18.6

SOCIETY B

HOSIERY

Men.

Total Membership	.	.	.	.	.	.	.	154
No. of Claims	.	.	.	.	.	.	.	23
Percentage of Claims	.	.	.	.	.	.	.	14.9

No. of Claims directly traceable to strain	3
Percentage of Members whose Claims were traceable to strain	1.9
Percentage of Claims directly traceable to strain	13.04

Women.

Total Membership	179
No. of Claims	46
Percentage of Claims	25.6
No. of Claims directly traceable to strain	14
Percentage of members whose claims were traceable to strain	7.8
Percentage of Claims directly traceable to strain	30.4

SOCIETY C

HOSIERY

Men.

Total Membership	93
No. of Claims	21
Percentage of Claims	22.5
No. of Claims directly traceable to strain	3
Percentage of Workers whose claims were traceable to strain	3.2
Percentage of Claims directly traceable to strain	14.2

Women.

Total Membership	90
No. of Claims	52
Percentage of Claims	57.7
No. of Claims directly traceable to strain	17
Percentage of Workers whose claims were traceable to strain	18.8
Percentage of Claims directly traceable to strain	32.6

JUTE AND FLAX INDUSTRY

Men.

Total Membership	1,300
No. of Claims exclusive of 40 Discharged Soldiers	285
Percentage of Claims	21.9
No. of Claims directly attributable to strain	37
Percentage of Members whose claims were attributable to strain	2.8
Percentage of Claims directly attributable to strain	12.9

Women.

Total Membership	3,400
No. of Claims	947
Percentage of Claims	27.8
No. of Claims due to strain	124
Percentage of Members whose Claims were due to strain	3.17
Percentage of Claims directly attributable to strain	13.09

Appendix E

WOOLWICH ARSENAL

The shifts are 2 of 12 hours each, inclusive of meal times, and 5 hours' overtime is worked frequently.

This makes a week of from 60-66 working hours for the women, and in addition the transport difficulties are so great that it often takes 2-2½ hours for them to get to their homes from their work.

The result is that the women lose a great deal of time through absence. They take days off and willingly pay the fines imposed. From the point of view of their health they say it is well worth being prosecuted.

The following figures were taken from cases at one sitting of a recent Munitions Court, when fines were imposed for absence without leave.

In each case, as no medical certificate had been given by the Arsenal authorities, the loss of time would be characterised as avoidable.

From the week ending 11th August to the week ending 15th September, 1917, the possible working hours were 338. These included 2 weeks of 65 hours each.

1.	A	lost	75	hours out of a possible	338.
2.	B	"	111	"	338.
3.	C	"	98	"	338.
4.	D	"	100	"	338.
5.	E	"	93	"	338.
6.	F	"	66	"	338.
7.	G	"	54	"	338.
8.	H	"	54	"	338.
9.	I	"	60	"	338.
10.	J	"	69	"	338.

N.B. I was on Mercury and used to take 1 day off at a time. This is a total of 780 hours lost out of 3,380 possible hours = $\frac{3}{13}$ or 23 per cent.

Appendix F

INCIDENCE OF ACCIDENTS

The most valuable and complete statistics came from Germany, the first country to adopt, in 1884, a comprehensive system of accident compensation on a national scale. Germany was one of the first nations to require that the hours of the incidence of accidents be reported.

The following table shows that during the year 1887 the highest accident rate, *for all industries*, occurred between 10 and 12 in the morning and between 5 and 6 in the afternoon.

NUMBER AND PER CENT. OF ACCIDENTS DURING THE YEAR 1887
BY HOUR OF THE DAY (GERMANY)

Hours.		Accidents.		Hours.		Accidents.	
Morning.	Number.	Per cent.		Afternoon.	Number.	Per cent.	
6 to 7 .	435	2.82		12 to 1 .	587	3.81	
7 " 8 .	794	5.16		1 " 2 .	745	4.84	
8 " 9 .	815	5.29		2 " 3 .	1,037	6.73	
9 " 10 .	1,069	6.94		3 " 4 .	1,243	8.07	
10 " 11 .	1,598	10.37		4 " 5 .	1,178	7.65	
11 " 12 .	1,590	10.31		5 " 6 .	1,306	8.48	

¹ Goldmark, *Fatigue and Efficiency*, p. 73.



A History of Factory Legislation

By B. L. HUTCHINS and A. HARRISON, D.Sc. (Econ.). With a Preface by SIDNEY WEBB. Second Edition Revised, with a New Chapter. Demy Svo. Cloth, 314 pp. 7s. 6d. net. *Inland Postage, 5d.*

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